

Early Detection and Rapid Response Plan for Myoporum Thrips (*Klambothrips myopori*) on O‘ahu



**O‘ahu Invasive Species Committee
Department of Land and Natural Resources, Division of Forestry and Wildlife
Hawai‘i Department of Agriculture, Plant Pest Control**

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I. INTRODUCTION

Myoporum thrips or naio thrips (*Klambothrips myopori*) is a recent invader to Hawai‘i. This insect pest was first detected in California in 2005, where it has caused high levels of mortality in ornamental *Myoporum* species used for landscaping in residential areas, parks and along road margins. The pest was first detected in 2008 attacking the native *Myoporum sandwicense*, locally known as naio. Hawai‘i Department of Agriculture (HDOA) was notified in February 2009, and subsequently initiated delimiting surveys to assess the extent of the infestation. Based on initial surveys it was determined that the pest was widely distributed across West Hawai‘i, but was not yet present on any other islands. HDOA moved to restrict the inter-island transport of all naio in May 2009. The restriction has subsequently been amended to restrict the movement of naio from Hawai‘i Island, but allows transport between islands where myoporum thrips are not yet present. To date, the distribution of myoporum thrips in the State remains restricted to Hawai‘i Island.

While naio is most dominant in dry forests, and lowland and upland shrublands, the species also populates mesic and wet forest habitats as well as coastal strand communities. Naio is distributed across all of the main Hawai‘ian Islands, and is present from sea-level to upwards of 3000 meters. The loss of this species would represent a significant biological and structural loss to native forest habitats. The decline or extinction of naio would be a cultural loss as well, as the wood of naio was utilized by native Hawai‘ians for purposes including, but not limited to, ornamental pieces and gunwales on outrigger canoes, house posts, fishing net spacers, and long-burning torches for night fishing.

Given their small size and documented ability to be transported over long-distances as a result of both natural and human-mediated causes, there is a high likelihood that myoporum thrips will further disperse within the State. The purpose of developing an early detection and rapid response plan for myoporum thrips is to increase awareness of this destructive pest, as well as provide protocol guidance, organization and facilitate cooperation between the following agencies: Department of Land and Natural Resources (DLNR), Hawai‘i Department of Agriculture (HDOA), O‘ahu Invasive Species Committee (OISC), O‘ahu Army Natural Resources Program (OANRP), and the United State Fish and Wildlife Service (USFWS).

Each agency will be responsible for monitoring select naio populations. This division of labor will decrease the workload of any single agency or organization and increase the monitoring focus from any one population. This plan outlines specific early detection and monitoring methods to increase the likelihood of detection in the event myoporum thrips are introduced to the island of O‘ahu, as well as rapid response protocols to increase the likelihood the pest will be contained or eradicated once it is detected.

It is necessary to assume pest detection so that a rapid response plan can be implemented, assuring the best probability toward pest eradication. Partners will have the ability to initiate a rapid and coordinated response, using both physical and chemical control methods, with the goal of eradicating myoporum thrips, and protecting O‘ahu’s naturally occurring naio populations.

II. BACKGROUND

A. Description of pest

Klambothrips myopori (Thysanoptera: Phlaeothripidae) are referred to as myoporum thrips or naio thrips. The insect is narrow, dark brown to black, approximately 2-2.5 mm, with fringed wings and a long posterior tube (Figure 1). It is a gall-inducing thrips, which causes damage to plants as a result of feeding with cone-like mouthparts. Immature thrips are shaped like the adults but vary in appearance from white to orange and are wingless (see Figure 2). Eggs are small, milky, and oblong in shape, and difficult to observe without magnification.



Figure 1. Adult *Klambothrips myopori*.



Figure 2. Immature *Klambothrips myopori*.

B. Native & exotic range

To date myoporum thrips have only been documented from California, Hawai'i and Tasmania. Myoporum thrips were first discovered in Southern California in 2005 and were linked to extensive damage of landscape and nursery stock of *Myoporum laetum*, a species that is not native to California. The thrips was undescribed prior to its detection in California; a species description was prepared and published in 2007 based on that discovery.

Myoporum thrips were detected on Hawai'i Island in December 2008. Given their wide distribution, and naio mortality observed at that time, it is likely the species was present on Hawai'i Island for several years prior to their initial identification. The pest has infested the north and west side of Big Island and is slowly spreading to the south and east. Survey data and observations of naio mortality indicate that the center of the infestation is in the saddle area between Mauna Kea and Mauna Loa, where naio is a key component of the native plant community.

Recent molecular data analyses have determined that myoporum thrips are native to Tasmania. Survey entomologists visited sites across Australia and New Zealand, and sampled thrips species on *Myoporum insulare*, a host plant native to the region. Molecular analyses confirm that California and Hawai'i populations are closely related to one another, as well as the population sampled in Tasmania.

C. Dispersal potential

The presence of *Klambothrips myopori* in Tasmania, demonstrates a history of successful dispersal across the 200-mile Bass Strait. This precedent indicates that the species is likely capable of naturally dispersing across the Hawai‘ian Islands as well. While wind dispersal of the species is possible, it is less likely that myoporum thrips will spread from its current range on Hawai‘i Island to O‘ahu via wind.

Myoporum thrips are not merely at risk of being moved naturally via wind, they are at risk of being moved through unintentional transport by people on plants and goods. The distribution of infested nursery stock played a role in the establishment of myoporum thrips at sites across Hawai‘i Island. Naio out-plants in the city of Hilo were found to be infested early in 2009 due to the transportation of infested nursery stock from nurseries in Waimea.

At this time, human mediated transport is the most likely pathway by which the species will disperse to O‘ahu. Given the number of visitors and residents who travel inter-island daily, as well as the continuous shipment of nursery plants and goods between islands, there exists a significant risk for transport and establishment of this pest species. O‘ahu is the epicenter for transport in the State, and the frequent movement of people and goods from Hawai‘i Island to O‘ahu provides an open pathway for myoporum thrips dispersal.

D. Biological impact

Adult and immature myoporum thrips feed on foliage, causing leaf distortion and induce the development of leaf-galls on host plants. Leaf curls/folds create protected areas in which the pest can feed and reproduce. Heavy infestations result in leaf curling, branch dieback, defoliation and host plant mortality (see Figure 3 & 4).



Figure 3. Curled and galled naio.



Figure 4. Beginning of leaf dieback.

E. Ecological impact

High levels of infestation and mortality have been observed at Hawai‘i Island monitoring sites over the last three years. Mortality rates have been increasing each year, ranging from 30-50%. And mortality of naio has been documented at over 90% at select sites.

If myoporum thrips were to become established on O‘ahu, it is likely that an infestation by the pest would result in comparable damage to O‘ahu naio populations. As on Hawai‘i

Island, ornamental naio out-plantings are included in landscape plantings on commercial properties, at resorts, and in some residential areas. Unlike on Hawai'i Island and Maui, naio occurs in lower densities in native habitats on O'ahu. While this could initially slow the dispersal of the pest, die back and mortality are still likely to result, and the probability of local extirpations of naturally occurring naio may increase.

Dieback and mortality of naio will necessarily impact the native fauna that rely on naio for food and/or habitat. Naio is a host to many insect herbivores, seed predators, borers and pollinators. Species that specialize on naio are at particular risk. However even species such as yellow-faced bees, which do not use the plant exclusively, but forage on it as a year-round nectar source, are likely to be adversely impacted.

On O'ahu, a morphologically unique variety of naio (*Myoporum sandwicense* var. *stellatum*) is present at the Pearl Harbor National Wildlife Refuge, Kalaeloa Unit, and may constitute a new species. If this population were to become infested, this variety would be at risk of extinction.

III. EARLY DETECTION

A. Monitoring interval

It will be the responsibility of each agency to monitor designated naio populations for myoporum thrips (Figure 5, Table 1). Not every agency will have access to the same resources, therefore monitoring intervals may vary. Naio populations should be monitored quarterly, or at a minimum of twice per year.

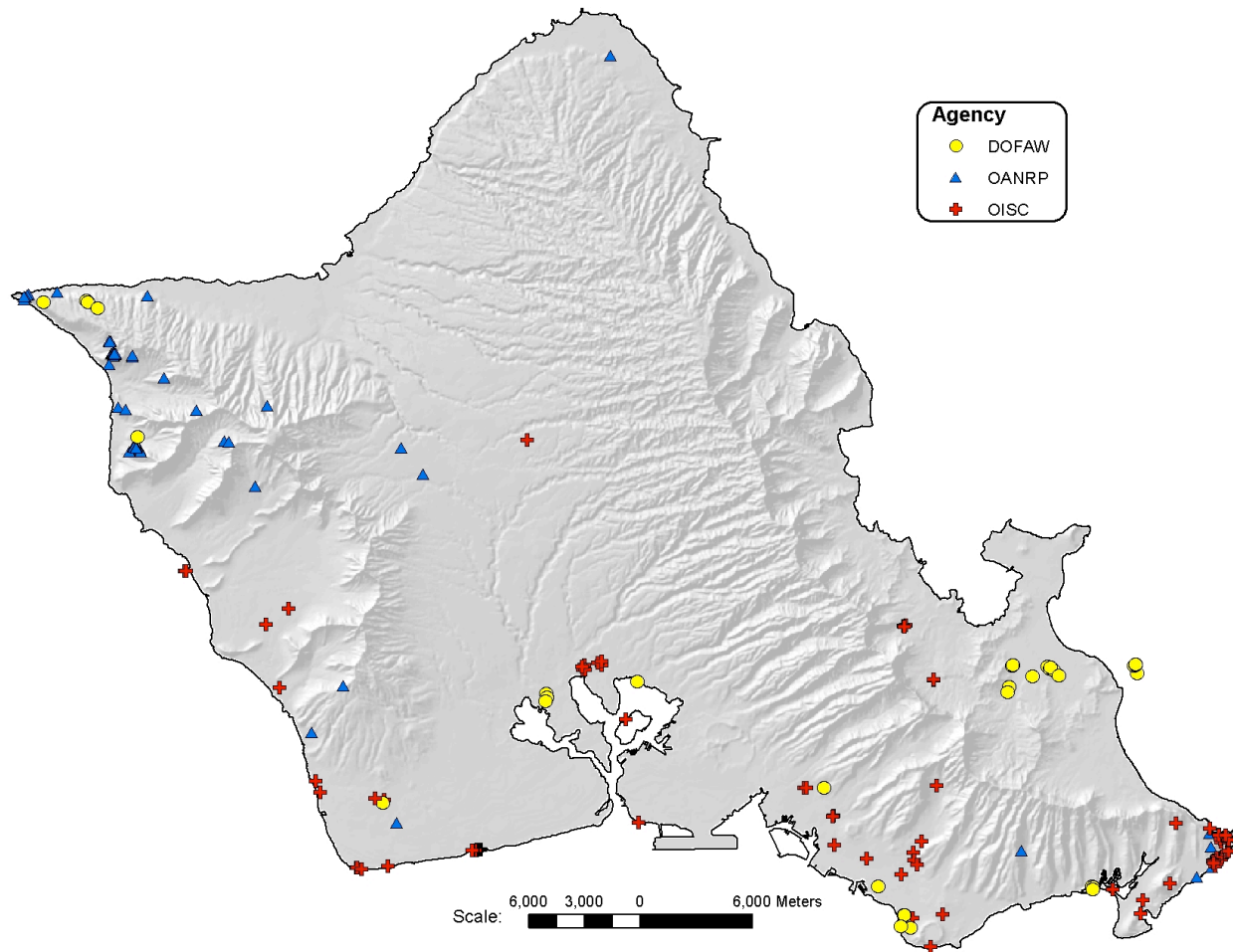


Figure 5. Map of naio populations on O'ahu with designation of agency responsible for monitoring.

B. Monitoring methods

- 1) Visit monitoring sites at scheduled intervals (monthly, bi-monthly, quarterly, semi-annually - to be determined by responsible agency/organization)
- 2) Visually inspect all naio present, OR a subset of naio plants (10 individuals in a given area), depending on the number of naio present at each site
- 3) Examine a minimum of 20 branches/leaf terminals on each plant for evidence of myoporum thrips presence
 - Curled and/or bumpy leaves, terminal dieback, or dead branches are all common indications of thrips presence
 - Chlorotic (yellowing/browning) leaves, or leaves that are limp, dead or dying but have no curls or bumps are not indicative of thrips damage
- 4) If myoporum thrips presence or damage is suspected:
 - Refer to Myoporum thrips field identification handout (Appendix D)
 - Photograph the suspected damage
 - Collect a sample and place in a sealed ziplock bag or otherwise secure container

- The sample should include the terminal branch where damage has been observed, and/or individual thrips
- 5) Every sample submitted for identification will be accompanied by the HDOA “Specimens Submitted for Identification” form (Appendix A)
- 6) Contact both HDOA and DLNR-DOFAW to inform of possible detection
- 7) If myoporum thrips are confirmed, follow protocol outlined in Figure 6.
- 8) If naio thrips are not detected, submit monitoring datasheets to DLNR-DOFAW Entomologist and/or Forest Health Specialist for data entry and management.

Materials list for naio monitoring

- 1) Datasheets
- 2) Hand clippers
- 3) Camera
- 4) Ziplock sealable sandwich bags
- 5) GPS

C. Monitoring sites

It is not possible to predict where myoporum thrips will first become established on O‘ahu. Areas such as airports and ports, which support high human and cargo traffic, frequently serve as initial points of infestation for new pest species. However on Hawai‘i Island it appears that myoporum thrips initially became established in an interior, natural area with limited access.

Monitoring sites have been identified on O‘ahu based on the presence of either out-planted or naturally occurring populations of naio. Businesses that may sell or transport potted naio plants have also been identified for monitoring. Each site has been assigned a priority level (1, 2, 3), to indicate the likelihood of infestation, and monitoring priority. Those that rank highest (1) are near potential entry sites such as ports and military bases; rank 2 sites are other easily accessible sites and important natural areas; and 3 are remote and isolated populations not likely to be sites of early introductions.

Table 1. Naio plant location descriptions and agencies responsible for monitoring.

Agency	Location Description	Locations	Plants	Priority level
USFWS	Pearl Harbor NWR – Kalaeloa Unit	36 acres	300-500	1
DOFAW	1942 Naio Street	1	1	2
DOFAW	3874 Leahi Street	1	1	2
DOFAW	Armed Forces Recreation Center of the Pacific	1	1	2
DOFAW	Costco Kapolei	1	1	2
DOFAW	Hamakua Marsh	5	?	3
DOFAW	Honolulu Zoo	2	6	2
DOFAW	Kaena Point NAR	?	?	2
DOFAW	Keaau Ridge Trail	1	?	2
DOFAW	Kuaokala	3	?	3
DOFAW	Mokulua Islands	4	?	3
DOFAW	Off of Kapaa Quarry Road	4	?	3
DOFAW	Paiko Lagoon	3	?	3

DOFAW	Pearl City Bike Path	1	1	2
DOFAW	Pouhala Marsh	3	?	3
DOFAW	Satellite Tracking Station Road	1	?	3
DOFAW	Ulupo Heiau State Monument	1	?	3
DOFAW	Waikiki Aquarium	1	2	2
OANRP	Across from Aquaculture Ponds	1	?	3
OANRP	Across Kal. Hwy from Makapuu Lookout	1	?	2
OANRP	Allen Davis	1	~100	2
OANRP	Barbers Point - Kalaeloa Airport	1	?	2
OANRP	Child Development Center Bldg. 1280	1	?	1
OANRP	Cliffside from across Makapuu Lookout	1	?	2
OANRP	Kaena	1	?	2
OANRP	Kaena Military Reservation	6	?	2
OANRP	Keaau	15	?	2
OANRP	Kealia Trail	1	?	3
OANRP	Keoneoio Gulch	1	?	3
OANRP	Makaha	2	?	3
OANRP	Makua Military Reservation	25	?	2
OANRP	Mokuleia Forest Reserve	1	?	3
OANRP	OANRP Baseyard	1	6	1
OANRP	Palehua	1	?	3
OANRP	Sandy Beach Park	1	?	2
OANRP	Waianae Kai Trail	1	5	3
OANRP	Wailupe	1	?	3
OISC	Ahua Wetland	1	32	1
OISC	Aulani	2	50	2
OISC	Barbers Point	5	10	2
OISC	Bishop Museum	2	5	2
OISC	Diamond Head Beach Park	1	1	2
OISC	Hale Halawai – UH Manoa	1	10	3
OISC	Hanauma Bay Nature Preserve	1	2	2
OISC	Hawaii Kai Towne Center	1	1	2
OISC	HDOA Main Office	1	2	2
OISC	Home Depot, Kapolei	1	6*	1
OISC	Home Depot, Pearl City	1	5*	1
OISC	Hoomaluhia Botanical Garden	1	2	3
OISC	Hui Ku Maoli Ola	3	>110*	1
OISC	Ka Iwi Shoreline Trail	3	15	2
OISC	Kalaeloa	14	45	2
OISC	Kalanimoku Building (1151 Punchbowl St.)	1	2	1
OISC	Kamehame Ridge	1	1	3
OISC	Kanewai Cultural Garden	1	2	3
OISC	Kapolei Commons – Bank of Hawai'i	1	10	2
OISC	Koko Crater Botanical Garden	1	3	1
OISC	Koko Head District Park	1	3	2
OISC	Kokua Market	1	1	2
OISC	Koolina	1	25	2

OISC	Leeward Community College	5	>28	2
OISC	Liliuokalani Botanical Garden	2	7	2
OISC	Lyon Arboretum	1	2	1
OISC	Makapuu Beach Park	1	1	2
OISC	Makapuu Lighthouse Trail	5	5	2
OISC	Makapuu Lookout	2	2	2
OISC	Manoa Public Library	1	4	2
OISC	Naio Building at KCC	1	1	1
OISC	NFL YET Hawaii Nanakuli Clubhouse	1	100	2
OISC	NOAA Ford Island	1	25	1
OISC	Oahu Urban Garden Center	2	3	2
OISC	Pokai Bay Beach Park	2	13	2
OISC	Queen Kapiolani Garden	3	4	2
OISC	St John Building - UH Manoa	1	1	1
OISC	Wahiawa Botanical Garden	1	1	1

*plant numbers vary depending on sales

Additional Sites to Consider:

- Home Depot, Iwilei (no naio present at time of survey)
- Lowe's, Iwilei (no naio present at time of survey)
- Lowe's, Waikale (no naio present at time of survey)
- Mokapu (MCBH by Pyramid Rock, check with Rick Barboza)
- Black Point (beachside, check with Rick Barboza)
- Oneula Beach Park (access Papipi Rd.) to Campbell Industrial Park (Barbers Point Beach Park) along length of beach. Kalaeloa Unit is in the middle of White Plains and Campbell Industrial Park (check with Rick Barboza)

IV. RAPID RESPONSE

A. Communication and delegation of responsibility

Once confirmed, the agency who detects the myoporum thrips will be responsible for notifying all other partner agencies (refer to Section V. Contacts).

If myoporum thrips are detected in a:

- 1) nursery or landscape planting, HDOA will take responsibility as lead agency
- 2) forest or natural area (non-federal lands) DLNR will take responsibility as lead agency in consultation with HDOA
- 3) USFWS Refuge, USFWS will take responsibility as lead agency in consultation with HDOA and DLNR
- 4) Army lands, OANRP will take responsibility as lead agency in consultation with HDOA and DLNR
- 5) Navy lands, the Navy will take responsibility as lead agency in consultation with HDOA and DLNR. OISC will be contracted to assist with surveys of naio on Navy lands

B. Restrict inter-island transport of naio from O‘ahu

In the event myoporum thrips are confirmed on O‘ahu, DLNR-DOFAW will submit a written request to the HDOA Administrator to immediately suspend the inter-island movement of naio plants from O‘ahu. The temporary ban on inter-island movement of naio plants should be enforced pending the completion of delimiting surveys to assess the distribution of the pest.

If it is determined that myoporum thrips are widely established on O‘ahu, and control measures are unlikely to be successful, HDOA could propose an interim rule to formalize the ban. If it appears that the infestation is localized and eradication is an option, the temporary HDOA ban will remain in place until after eradication efforts are determined to have been successful.

C. Physical control

Plants less than 2 meters in height which are confirmed to host myoporum thrips will be immediately targeted for removal. If permission is obtained from the landowner, plants will be cut and vegetation will be bagged and removed for disposal.

- 1) Spray infested plants liberally with insecticidal soap or oil (ex. Safer® Brand Insect Killing Soap or Safer® Brand BioNEEM Insecticide/Repellent). Focus the spray on areas suspected to be infested, and leaf terminals closest to the apical meristem where myoporum thrips tend to aggregate.
- 2) Carefully clip off branches suspected to be infested with myoporum thrips and place them in durable garbage bags.
- 3) When all infested vegetation has been removed, cut and pack the remainder of the vegetation into durable garbage bags for disposal.
- 4) Ensure that bags containing infested vegetation are carefully sealed, and handled/transported with care to reduce likelihood of the bags ripping or tearing.

- 5) Bags containing infested material can be transported to the City and County of Honolulu H-Power facility for ultimate disposition. Both OISC and DLNR-DOFAW Administration have approval to transport waste to the facility. State of Hawai'i vehicle license# E831: 2003 Chevrolet Suburban is specifically registered transport to the facility. To add other vehicles to this DLNR-DOFAW account, contact Margaret Vendetta (mvendetta@honolulu.gov).
- 6) H-Power must be contacted at (808) 682-0261, after 2pm. The vehicle should be driven onto the scale at the entrance, and a red light and green light will indicate when the driver should proceed. The attendant at the entry will then direct the driver to the upper or lower dumping area. The vehicle will be weighed again upon exiting, and the driver will receive a ticket from the machine at the weigh-out station with information about the weight of the load.
- 7) Where possible, individuals who conduct removal efforts for infested naio should change into clean clothing immediately following project completion. Clothing worn during naio removal should be bagged and laundered (washed and dried in a dryer) before being worn again to any field site.

Materials list for physical control:

- 1) Insecticidal soap or oil
- 2) Rubber or latex gloves
- 3) Hand clippers
- 4) Loppers
- 5) Durable garbage bags
- 6) Change of clothing

D. Chemical control

Naio plants may be chemically treated prior to assessing removal options, or as an alternative to removal options if 1) the area of infestation is extensive, 2) permission is not given to remove the infested plants, or 3) the naio is located in a natural area.

- 1) Myoporum thrips confirmed to be present in a **landscape planting** (ornamentals, commercial, industrial, institutional and recreational areas including athletic field and parks). Plants should be treated with both a soil drench and a foliar spray.
 - Safari (Dinotefuran) may be used as a soil drench and/or as a foliar spray
 - Allectus (Imidacloprid+Bifenthrin) may be applied as a soil drench and/or as a foliar spray
- 2) Myoporum thrips confirmed to be present in a **nursery**:
Plants should be treated with both a soil drench and a foliar spray.
 - Safari (Dinotefuran) may be used as a soil drench and/or as a foliar spray
- 3) Myoporum thrips confirmed to be present in a **natural area**:
Plants should be treated with both a soil drench and a foliar spray.

- Safari (Dinotefuran) may be used as a soil drench and/or as a foliar spray, but may not be used when a naio plant is flowering.

Individuals who conduct control efforts for infested naio should change into clean clothing immediately following treatment. Clothing worn during naio treatment should be bagged and laundered (washed and dried in a dryer) before being worn again to any field site.

Following treatment, sites should be checked weekly for evidence of myoporum thrips presence to assess efficacy of treatment, and determine whether further action is needed (ex. physical removal of the plant or treatment with non-restricted insecticidal soaps or oils). Systemic insecticides will be reapplied per label specifications, two weeks following the initial treatment. Research suggests that successful systemic insecticide treatments kept plants free of naio thrips for 60 days, therefore plants should be checked weekly until 60 days post treatment(s), at which point control options will be reassessed.

Materials list for chemical control:

- 1) Insecticide
- 2) Water
- 3) Sprayer/pesticide applicator
- 4) Personal protective equipment (eyewear, long-sleeves, gloves, closed toed shoes)
- 5) Durable garbage bags
- 6) Change of clothing

E. Delimiting surveys and prophylactic control

Immediately following the detection and confirmation of myoporum thrips on O‘ahu, delimiting surveys of naio plants will be conducted within a 3-mile radius of the known point or area of infestation. Where possible, surveys may also be completed to assess naio populations outside this radius. If the pest is confirmed to be present at additional sites, the surveys will expand accordingly across the island.

If permissions are obtained, naio plants within the 3-mile radius buffer zone will be treated with a systemic insecticide to prevent the establishment of myoporum thrips that may still be present in the area. These naio populations will also be monitored every two weeks following treatment. Further control options will be assessed at 60 days post treatment, and will be determined based on the efficacy of control measures implemented in the area of infestation.

F. Outreach

Outreach must be conducted to inform landscapers, horticulturalists, nurseries and other businesses that handle naio plants. Outreach could be conducted in person through site visits, and/or by sending a notice to the individual or business (Appendix C).

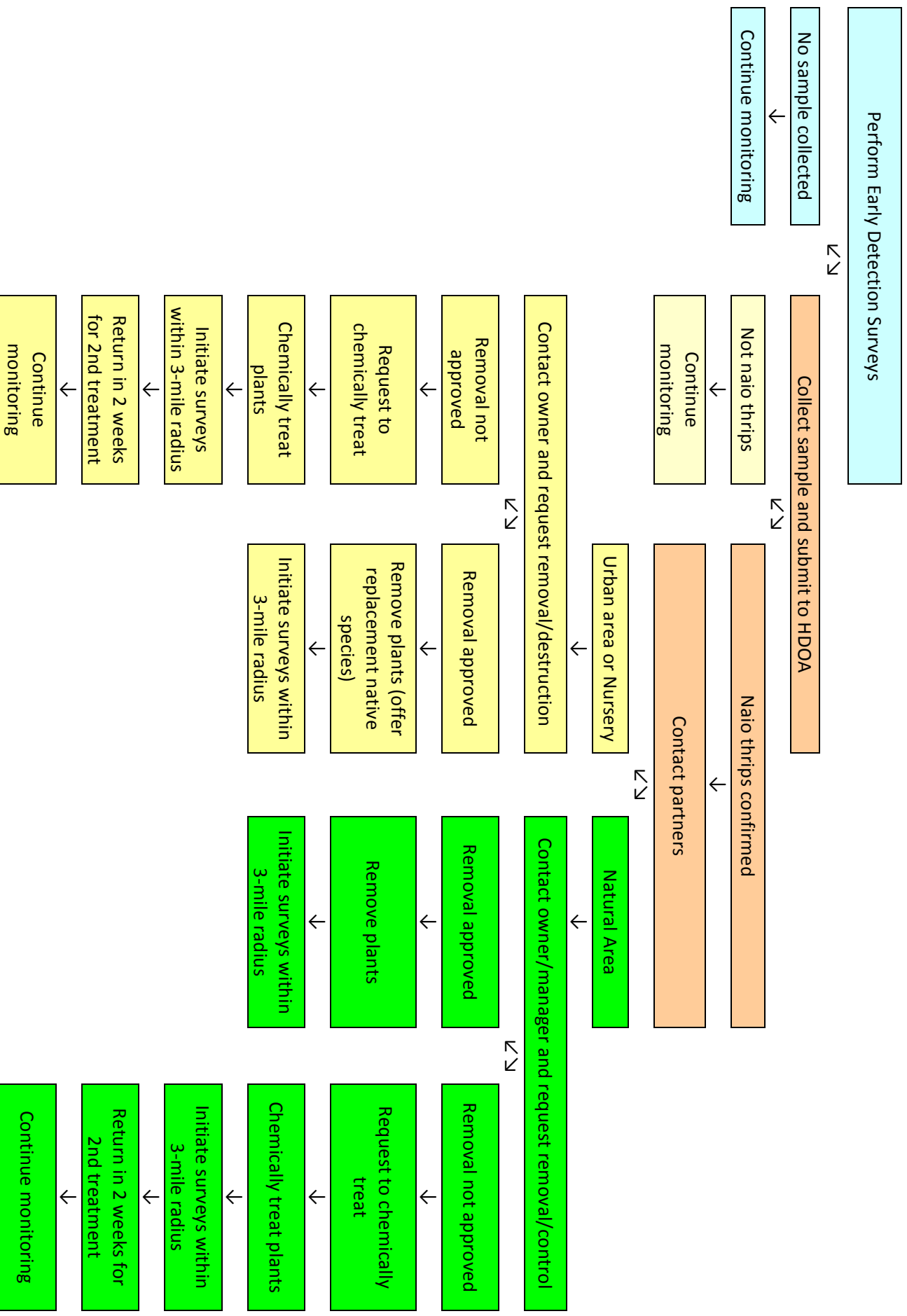


Figure 6. Flowchart explaining the protocol for naito thrips monitoring, detection, and eradication.

V. RECOMMENDATIONS

- Contact HDOA to request a permanent rule to restrict the transport of naio from Hawai'i Island.
- Continue to survey for new naio populations on O'ahu.
- Hold annual meetings to revisit Early Detection and Rapid Response Plan with partners and relevant staff.
- Develop an Adopt-a-Naio Program as an outreach tool to increase detection potential of naio populations and myoporum thrips.
- Develop a flyer/fact sheet/brochure for vendors selling naio to the public on what to look out for.

VI. REFERENCES

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VII. CONTACTS

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Honolulu Zoo – Baird Flemming, Assistant Director

Waikiki Aquarium - Jerry Crow, jcrow@Hawai‘i.edu (808) 271-2251

VIII. APPENDICES

Appendix A. Hawai'i Department of Agriculture specimen submittal form.

PPC-24 6/09	PPC-24 6/09
<p>Specimens Submitted for Identification Hawaii State Dept. of Agriculture, Plant Pest Control Branch</p> <p>Island/State/Country: _____</p> <p>Location: _____</p> <p>Collected by: _____ Date: _____</p> <p>Submitted by: _____ Date: _____</p> <p>Habitat: _____</p> <p>Host (Scientific Name): _____</p> <p>Host (Common Name): _____</p> <p>Plant Part Affected: <input type="checkbox"/> Foliage <input type="checkbox"/> Fruit <input type="checkbox"/> Flower <input type="checkbox"/> Seeds <input type="checkbox"/> Stem <input type="checkbox"/> Trunk <input type="checkbox"/> Roots </p> <p>Plant Symptoms: _____</p> <p>Degree of Infestation: <input type="checkbox"/> Light <input type="checkbox"/> Medium <input type="checkbox"/> Heavy</p> <p>Insect Stage Collected: <input type="checkbox"/> Immature <input type="checkbox"/> Pupa <input type="checkbox"/> Adult</p> <p>Notes: _____</p>	<p>Specimens Submitted for Identification Hawaii State Dept. of Agriculture, Plant Pest Control Branch</p> <p>Island/State/Country: _____</p> <p>Location: _____</p> <p>Collected by: _____ Date: _____</p> <p>Submitted by: _____ Date: _____</p> <p>Habitat: _____</p> <p>Host (Scientific Name): _____</p> <p>Host (Common Name): _____</p> <p>Plant Part Affected: <input type="checkbox"/> Foliage <input type="checkbox"/> Fruit <input type="checkbox"/> Flower <input type="checkbox"/> Seeds <input type="checkbox"/> Stem <input type="checkbox"/> Trunk <input type="checkbox"/> Roots </p> <p>Plant Symptoms: _____</p> <p>Degree of Infestation: <input type="checkbox"/> Light <input type="checkbox"/> Medium <input type="checkbox"/> Heavy</p> <p>Insect Stage Collected: <input type="checkbox"/> Immature <input type="checkbox"/> Pupa <input type="checkbox"/> Adult</p> <p>Notes: _____</p>
<p>Order: _____ Family: _____</p> <p>Genus/Species/Author: _____</p> <p>Common Name: _____</p> <p>Det. by: _____ Date: _____</p> <p>No. of specimens to be added to collection: Pinned _____ Vials _____ Slides _____</p> <p>New Record: _____ <input type="checkbox"/> Entered in Database</p>	<p>Order: _____ Family: _____</p> <p>Genus/Species/Author: _____</p> <p>Common Name: _____</p> <p>Det. by: _____ Date: _____</p> <p>No. of specimens to be added to collection: Pinned _____ Vials _____ Slides _____</p> <p>New Record: _____ <input type="checkbox"/> Entered in Database</p>

Appendix C. Myoporum thrips field identification handout.



Damage commonly observed on naio plants (NOT Myoporum Thrips)



Issue: Drought is an issue at many sites in dry areas.

What to look for: Leaves will droop and/or turn yellow or brown in color.



Issue: Other homopteran pests such as aphids, mealybugs, lacebugs and leafhoppers can cause damage to naio.

What to look for: Leaf bends or gentle curls often mark the site where feeding has occurred and can be mistaken for myoporum thrips damage. In contrast, myoporum thrips damage is bumpy or pock-marked in appearance.



Issue: Several stressors can impact the same plant. A combination of drought and mealy bug damage can be seen in this photo.

What to look for: Mealybugs and/or the white waxy substance they exude. Speckles of black sooty mold may also be seen on the naio leaves. This mold commonly grows on mealy bug and leafhopper exudate (waste). Sooty mold is not associated with naio thrips.



Issue: Lacebugs can experience episodic outbreaks on naio.

What to look for: Feeding damage from these insects will cause naio leaves to turn yellow or brown in color, and curl gently. An adult lacebug (top of photo), and white immatures are usually visible on the foliage.

Appendix D. Myoporum thrips field monitoring datasheet.

Site: _____ **Infestation level:** 0 = no galls 0 = no die back
 1 = <1 - 33% galled 1 = <1 - 33% die back
Date: _____ 2 = 34-66 % galled 2 = 34-66 % die back
Observer: _____ 3 = > 66% galled 3 = > 66% die back

		Tree									
		1	2	3	4	5	6	7	8	9	10
Growth											
% tree canopy											
% dead branches											
natural enemies											
Notes											
Branch number	Infestation	Die back	Infestation	Die back	Infestation	Die back	Infestation	Die back	Infestation	Die back	Infestation
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

natural enemies: spiders, ladybugs (adults or larvae), lacewing (larva), anthracodidae (pirate bug), etc